

## Long Range Optical Telecommunications

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The official link for this solicitation is: <http://sbir.nasa.gov/SBIR/sbirsttr2011/solicitation/index.html>

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### Description:

This subtopic seeks innovative technologies for long range Optical Telecommunications supporting the needs of space missions. Proposals are sought in the following areas:

Systems and technologies relating to acquisition, tracking and sub-micro-radian pointing of the optical communications beam under typical deep-space ranges (to 40 AU) and spacecraft micro-vibration environments. Within these domains of interest, desired proposal focus areas to develop and/or demonstrate technologies are as follows:

#### **Isolation Platforms**

Compact, lightweight, space qualifiable vibration isolation platforms for payloads massing between 3 and 50 kg that require less than 15 W of power and mass less than 3 kg that will attenuate an integrated angular disturbance of 150 micro-radians from 0.01 Hz to 500 Hz to less than 0.5 micro-radians 1-sigma.

#### **Laser Transmitters**

Space-qualifiable, greater than 20% DC to optical efficiency, 0.2 to 16 nanosecond pulse-width 1550-nm laser transmitter for pulse-position modulated data with from 16 to 320 slots per symbol, less than 35 picosecond pulse rise and fall times, near transform limited spectral width, single polarization output with at least 20 dB polarization extinction ratio, amplitude extinction ratio greater than 38 dB, average power of 5 to 20 Watt, massing less than 500 grams per Watt. Also of interest

for the laser transmitter are: robust and compact packaging with radiation tolerant electronics inherent in the design, and high speed electrical interface to support output of pulse position modulation encoding of sub nanosecond pulses and inputs such as Spacewire, Firewire or Gigabit Ethernet. Detailed description of approaches to achieve the stated efficiency is a must.

## **Photon Counting Near-Infrared Detectors Arrays for Ground Receivers**

Hexagonal close packed kilo-pixel arrays sensitive to 1000 to 1650 nm wavelength range with single photon detection efficiencies greater than 60% and single photon detection jitters less than 40 picoseconds 1-sigma, active diameter greater than 15 microns/pixel, and 1 dB saturation rates of at least 10 mega-photons (detected) per pixel and dark count rates of less than 1 MHz/square-mm.

## **Photon Counting Near-Infrared Detectors Arrays for Flight Receivers**

For the 1000 to 1600 nm wavelength range with single photon detection efficiencies greater than 40% and 1dB saturation rates of at least 1 mega-photons/pixel and operational temperatures above 220K and dark count rates of <10 MHz/mm. Radiation doses of at least 20 Krad (unshielded) shall result in less than 10% drop in single photon detection efficiency and less than 2X increase in dark count rate.

## **Ground-Based Telescope Assembly**

Telescope/photon-buckets with primary mirror diameter ~2.5-m, f-number of ~1.1 and Cassegrain focus to be used as optical communication receiver/transmitter optics at 1000-1600nm. Maximum image spot size of ~20 micro-radian, and field-of-view of a~50 micro-radian. Telescope shall be positioned with a two-axis gimbal capable of 0.25 milli-radian pointing. Desired manufacturing cost for combined telescope, gimbal and dome in quantity (tens) of approximately \$2 M each.

Research should be conducted to convincingly prove technical feasibility during Phase I, ideally through hardware development, with clear pathways to demonstrating and delivering functional hardware, meeting all objectives, in Phase II.

### Phase I Deliverables:

- Feasibility study, including simulations and measurements, proving the proposed approach to develop a given product (TRL 3-4).
- Verification matrix of measurements to be performed at the end of Phase II, along with specific quantitative pass-fail ranges for each quantity listed.

### Phase II Deliverables:

- Working model of proposed product, along with full report of development and measurements, including populated verification matrix from phase II (TRL 5).
- Opportunities and plans should also be identified and summarized for potential commercialization.